

REMARKS

Reconsideration of the application in light of the following remarks is respectfully requested.

Status of the Claims


Claims 7 - 10 and 18 - 35 are currently pending in the present application, with claims 1 - 6 and 11 - 17 having previously been canceled. Applicants cancel claims 10, 20, 23, 28 - 31, 34 and 35 without prejudice or disclaimer, and amend claims 7, 24, 25 and 26. No new matter is introduced.

Rejection under 35 U.S.C. § 103

Claims 7 - 10 and 18 - 35 are rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,180,263 to Naoi ("Naoi") or U.S. Patent No. 6,087,025 to Dearnaley et al. ("Dearnaley") or U.S. Patent No. 6,904,935 to Welty et al. ("Welty") in view of U.S. Patent No. 6,284,376 to Takenouchi et al. ("Takenouchi") and U.S. Patent No. 6,740,393 to Massler et al. ("Massler"). As claims 10, 20, 23, 28 - 31, 34 and 35 are canceled, Applicants submit that the rejections as to claims 10, 20, 23, 28 - 31, 34 and 35 are thereby moot. Applicants traverse the rejections of claims 7 - 9, 18, 19, 21, 22, 24 - 27, 32 and 33 under 35 U.S.C. §103(a).

In amended independent claim 7, Applicants claim:

7. An amorphous carbon film, comprising:

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an amorphous carbon layer; and

an interlayer disposed between a base material and the amorphous carbon layer, said interlayer containing at least one substance selected from the group consisting of B, Al, Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, and W, and said interlayer having a thickness of 0.5 nm or greater 10 nm or less;

wherein on a base material side of said interlayer, there is a mixed layer which contains portions of the base material and the interlayer material and which has a thickness of 0.5 nm or greater and 10 nm or less,

wherein an average oxygen concentration contained in said mixed layer or in said mixed layer and interlayer is 1 at % or less,

wherein a concentration of carbon in the amorphous carbon layer is 99.5 at % or greater, a concentration of hydrogen in the amorphous carbon layer is 0.5 at % or less, a concentration of a rare gas element in the amorphous carbon layer is 0.5 at % or less, and

wherein the amorphous carbon film is formed by:

executing a cathode arc ion plating method, with solid carbon as raw material and under an atmosphere with a degree of vacuum of 0.05 Pa or lower.

(Emphasis added).

The Examiner suggests that each of Naoi, Dearnaley and Welty disclose an amorphous carbon film as claimed by Applicants, but acknowledges that none of Naoi, Dearnaley and Welty “explicitly disclose the thickness of the mixed components within the layers [as claimed by Applicants].” The Examiner however suggests that Takenouchi and Massler disclose the use of mixed intermediate layers to improve adherence, and that it would have been obvious to one skilled in the art at the time of invention to provide the additional layers of mixed components as claimed by Applicants. Applicants respectfully disagree.

Applicants acknowledge that it is known to produce an amorphous carbon film having a mixed layer at the interface between the film and an underlying substrate (see, e.g., page 5, line 13 - page 8, line 4 of Applicants’ specification). Applicants also acknowledge that prior art films of this type have exhibited problems with respect to heat resistance and adhesion. In order to

address these problems, and through significant experimentation, Applicants discovered that certain material problems of the film were of critical significance. For example, Applicants discovered that minimizing the concentration of oxygen (i.e., at less than 1 at%) in the mixed layer and/or interlayer is critical for providing stable adhesion properties in the film (see, e.g., page 19, lines 9 - 16 of Applicants specification). In addition, Applicants discovered that minimizing the amount of hydrogen in the amorphous carbon film (i.e., 0.5 at% or less) is critical for achieving a film structure that is sufficiently hard and that exhibits sufficient heat resistance (see, e.g., page 14, line 18 - page 15, line 3 of Applicants' specification).

Takenouchi discloses an ornamental article comprising a base material upon which a hard carbon film is disposed over an intermediate layer (see, e.g., abstract of Takenouchi). While Takenouchi acknowledges the presence of hydrogen and oxygen gases during the formation of the film, Takenouchi fails to teach or suggest the reduced levels of oxygen and hydrogen claimed by Applicants for improved adhesion and improved adhesion and hardness, respectively.

Massler discloses a diamond-like carbon (DLC) coating having an intermediate Si layer and an adjoining a-SiC:H transition zone for improving the adhesion of the DLC coating to the base (see, e.g., Col. 2: 51 - 64 of Massler). In sharp contrast to Applicant's claimed invention, Massler fails to teach or suggest oxygen as a component of the intermediate layer. While Massler does acknowledge the presence of hydrogen, Massler fails to teach or suggest the reduced levels of hydrogen claimed by Applicants for improved heat resistance and hardness.

For at least the above-argued reasons, Applicants submit that amended independent claim 7 is not made obvious by any of the cited references, either alone or in combination, and that claim 7 therefore stands in condition for allowance. As each of claims 8, 9, 18, 19, 21, 22, 25 -

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27, 32 and 33 depends either directly or indirectly from allowable claim 7, Applicants further submit that dependent claims 8, 9, 18, 19, 21, 22, 25 - 27, 32 and 33 are also allowable for at least this reason.

Therefore, Applicants respectfully request that the rejection of claims 7 - 9, 18, 19, 21, 22, 25 - 27, 32 and 33 U.S.C. §103(a) be withdrawn.

CONCLUSION

Each and every point raised in the non-final Office Action mailed November 27, 2007 has been addressed on the basis of the above amendments and remarks. In view of the foregoing it is believed that claims 7 - 9, 18, 19, 21, 22, 24 - 27, 32 and 33 are in condition for allowance, and it is respectfully requested that the application be reconsidered and that all pending claims be allowed and the case passed to issue.

If there are any other issues remaining which the Examiner believes could be resolved through a Supplemental Response or an Examiner's Amendment, the Examiner is respectfully requested to contact the undersigned at the telephone number indicated below.

Dated: February 19, 2008

Respectfully submitted,

By 

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